

1. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the
5 extractor cup, comprising:

the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending into the interior of the extractor cup,

the filament being pre-coated with a conductive metal
10 precursor which will evaporate from the filament and deposit conductive material on adjacent surfaces when the filament is initially heated to a predetermined temperature,

the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and
15 the extractor cup being secured to the base during assembly of the x-ray tube, and

a shield positioned on one of the filament posts to shadow an area of the base adjacent to the one post from receiving any coating from the conductive material when evaporated off the
20 filament,

whereby after the cathode and the x-ray tube are fully assembled and evacuated, the cathode filament can be heated to such predetermined temperature to evaporate the conductive precursor material to deposit the conductive material on the base

and on the extractor cup, thereby connecting one side of the filament to the extractor cup via the base, so that the extractor cup will be at the high voltage potential of one side of the filament during operation of the x-ray tube.

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2. The miniature x-ray tube of claim 1, wherein the conductive metal precursor comprises gold, whereby the interior of the extractor cup becomes coated with a reflective coating and thus reduces heat loss into the extractor, reducing power
10 required to operate the filament.

3. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the
15 extractor cup, comprising:

the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending into the interior of the extractor cup,

the filament being pre-coated with a semiconductor material
20 which will evaporate from the filament and be deposited on adjacent surfaces when the filament is initially heated to a predetermined temperature, and

the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and

the extractor cup being secured to the base during assembly of the x-ray tube,

whereby after the cathode and x-ray tube are fully assembled and evacuated, the cathode filament can be heated to such
5 predetermined temperature to evaporate and deposit the semiconductor material on the base and on the extractor cup, thereby connecting with semiconductor material the filament to the extractor cup via the base and posts, so that the extractor cup will be essentially at the high voltage potential of the
10 filament during operation of the x-ray tube and excess charge buildup on the extractor cup can be drained.

4. The miniature x-ray tube of claim 3, wherein the semiconductor material as deposited on the base has a resistance
15 of about 200,000 to 300,000 ohms, in a miniature x-ray tube having an outside diameter in the range of about 1mm to 2mm.

5. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the
20 cathode, a means of connecting high voltage potential to the extractor cup, comprising:

the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending into the interior of the extractor cup,

a conductor which flows when heated to a predetermined temperature being placed on the base, to extend between one of the posts and a wall of the extractor cup, and

the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and the extractor cup being secured to the base during assembly of the x-ray tube,

whereby after the cathode is fully assembled the cathode filament can be heated to such predetermined temperature to flow the conductor to form a permanent conductive path between the filament supporting post and the wall of the extractor cup.

6. The miniature x-ray tube of claim 5, wherein the conductor comprises a sheet of braze foil lying flatly against the base and contacting a filament post and the wall of the extractor.

7. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the extractor cup, comprising:

the cathode filament being supported on upstanding leads from a cathode base, the leads being conductive,

the extractor cup comprising a hollow shape with conductive

material at least on an inner surface of the extractor cup, and the extractor cup being secured to the base during assembly of the x-ray tube, and

5 a spring conductor extending across the interior of the hollow extractor cup and in contact with one of the cathode filament supporting leads and in contact with the extractor cup wall at opposed locations in the extractor cup, the spring conductor being deflected to a curving shape by confinement within the extractor cup and by firm engagement against the one
10 lead, thereby providing a conductive path between the interior extractor cup wall and the one lead.

8. The x-ray tube of claim 7, wherein the spring conductor comprises a flat, elongated spring strip.

15 9. The x-ray tube of claim 7, wherein the cathode filament supporting leads comprise two generally parallel posts.

20 10. The x-ray tube of claim 7, wherein the cathode filament supporting leads comprise coaxial leads, an outer lead surrounding an inner lead, the spring conductor engaging against the outer lead.

11. In a miniature x-ray tube having a cathode with a

cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the extractor cup, comprising:

the cathode filament being supported on upstanding leads
5 from a cathode base, the leads being conductive,

the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and the extractor cup being secured to the base during assembly of the x-ray tube,

10 the filament leads being coaxial, with an outer conductive lead surrounding an inner conductive lead, and

conductive means extending between the outer coaxial filament supporting lead and an inner wall of the extractor cup and forming an electrical path between the outer lead and the
15 extractor cup wall.

12. The x-ray tube of claim 11, wherein the conductive means comprises a conductive bottom plate secured to the extractor cup and comprising said cathode base, the bottom plate having a hole
20 and being fitted over the outer conductive lead so as to make contact with the outer conductive lead and conduct high voltage potential to the extractor cup.

13. The x-ray tube of claim 11, wherein the conductive means

comprises a piece of conductive metal assembled between the outer coaxial conductive lead and the wall of the extractor cup and forming a conductive path between the two.

5 14. The x-ray tube of claim 13, wherein the piece of conductive metal comprises at least one spring clip positioned between the outer coaxial lead and the extractor wall and bearing firmly against the outer coaxial lead and the wall in springing relationship.

10 15. The x-ray tube of claim 11, wherein the conductive means comprises a pair of wires on opposed sides of the outer coaxial conductive lead, the two wires being in electrical contact with the outer coaxial lead and each wire having two ends each of
15 which extends into contact with the wall of the extractor cup.

 16. The x-ray tube of claim 15, wherein each wire is brazed or welded to the outer coaxial lead.

20 17. The x-ray tube of claim 11, wherein the conductive means comprises a pair of spring wires extending in opposed positions against the outer coaxial lead and crossing over each other, each wire having two ends each of which is in contact with the wall of the extractor cup.

18. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the extractor cup, comprising:

5 the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending into the interior of the extractor cup,

 the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and
10 the extractor cup being secured to the base during assembly of the x-ray tube,

 the extractor cup having a conductive bottom plate connected to the bottom of the extractor cup, the bottom plate having an opening through which the filament supporting posts extend up
15 into the extractor cup, the opening being non-symmetrical about the filament supporting posts, and the bottom plate being rotated in position on assembly such that an edge of the opening engages firmly against one of the filament supporting posts, and

 the extractor cup and bottom plate being secured to the
20 cathode base so that the conductive bottom plate is fixed in position.

19. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the

cathode, a means of connecting high voltage potential to the extractor cup, comprising:

the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending
5 into the interior of the extractor cup,

the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and the extractor cup being secured to the base during assembly of the x-ray tube,

10 a wire extending from one end of the cathode filament and into electrical contact with a wall of the extractor cup.

20. The x-ray tub of claim 19, wherein the wire has a braze alloy coated on its end, which has been melted during heating of
15 the cathode to firmly secure the end of the wire to the extractor wall.

21. The x-ray tube of claim 19, wherein the end of the wire lies against the cathode base and over a peripheral edge of the
20 cathode base, and wherein the extractor cup has a bottom end with an inside diameter slightly larger than an outside diameter of the cathode base, the extractor cup being assembled down over the periphery of the cathode base and pinching the end of the wire between the cathode base and the inside diameter of the

extractor cup at its bottom end, thereby making electrical connection between the wire and the inner surface of the extractor cup.

5 22. The x-ray tube of claim 21, wherein the cathode base comprises a heated and cured preform glass, fixed to the extractor cup and firmly retaining the wire end after assembly and heat curing.

10 23. The x-ray tube of claim 19, wherein the wire extending from a filament end comprises an extending tail of the filament itself, the filament being fixed to both posts and continuing from one of the posts to a contact with the inner surface of the extractor cup.

15 24. The x-ray tube of claim 19, wherein the wire comprises a discrete wire different from the filament, the filament support posts having hollow upper ends and the wire being co-crimped into the upper end of one of the posts along with an end of the
20 filament.

 25. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the

extractor cup, comprising:

the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending into the interior of the extractor cup,

5 the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and the extractor cup being secured to the base during assembly of the x-ray tube,

10 one of the filament support posts being longer than the other and extending beyond the filament, the extractor cup being assembled onto the cathode base down over the filament supporting posts such that the end of the longer post engages directly against the inner surface of the extractor cup.

15 26. The x-ray tube of claim 25, wherein the longer filament supporting post has an outward bend near its end.

20 27. The x-ray tube of claim 25, wherein the extractor cup is generally dome-shaped and has an upper central opening and wherein the longer post is positioned outwardly from the center of the extractor cup sufficiently to be positioned to engage an upper part of the inner surface of the extractor cup near the opening.

28. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the extractor cup, comprising:

5 a single filament support post as a first conductive filament lead extending into the interior of the extractor cup and supporting one end of the cathode filament,

 the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and
10 the extractor cup being secured to the base during assembly of the x-ray tube,

 the cathode filament having a second end opposite said on end, the second end being secured to the inner surface of the extractor cup, and

15 a second conductive lead extending from the cathode base into connection with the inner surface of the extractor cup.

29. The x-ray tube of claim 28, wherein the inner surface of the extractor cup has a recess or hole within which the second
20 end of the filament is received.

30. The x-ray tube of claim 28, wherein the second end of the filament is secured to the extractor cup by brazing.

31. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the cathode, a means of connecting high voltage potential to the extractor cup, comprising:

5 the cathode filament being supported on posts from a non-conductive cathode base, the posts being conductive and extending into the interior of the extractor cup,

 the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and
10 the extractor cup being secured to the base during assembly of the x-ray tube, and

 an end of one of the filament support posts being crimped onto an end of the cathode filament, in an elongated crimp deforming the metal of the post outwardly to a position such that
15 the crimped post contacts the inner surface of the extractor cup, thereby connecting high voltage to the extractor cup.

32. In a miniature x-ray tube having a cathode with a cathode filament, an anode and an extractor cup adjacent to the
20 cathode, a high voltage connection to the extractor cup, comprising:

 the cathode filament being connected to a pair of high voltage cathode leads and positioned within the interior of the extractor cup, with a non-conductive cathode base supporting the

leads and the filament,

the extractor cup comprising a hollow shape with conductive material at least on an inner surface of the extractor cup, and the extractor cup being secured to the base during assembly of the x-ray tube, and

a third high voltage lead electrically connected to the inner surface of the extractor cup, with a means connected to the third high voltage lead for varying voltage at the extractor cup to place a bias on the extractor cup to control electron flow from the cathode.